# A balancing puzzle

Start with a simple rotor system with two matched bearings with the usual damping, two matched masses on a uniform shaft, no gyroscopics and no tricks. The system rotates counterclockwise and is perfectly balanced initially. First, place the masses inboard of the bearings with an imbalance at 0° (with respect to a vertical transducer) on the left (inboard) mass only. The synchronous response is:



| Inboard | Outboard | Inboard | Outboard |
|---|---|---|---|
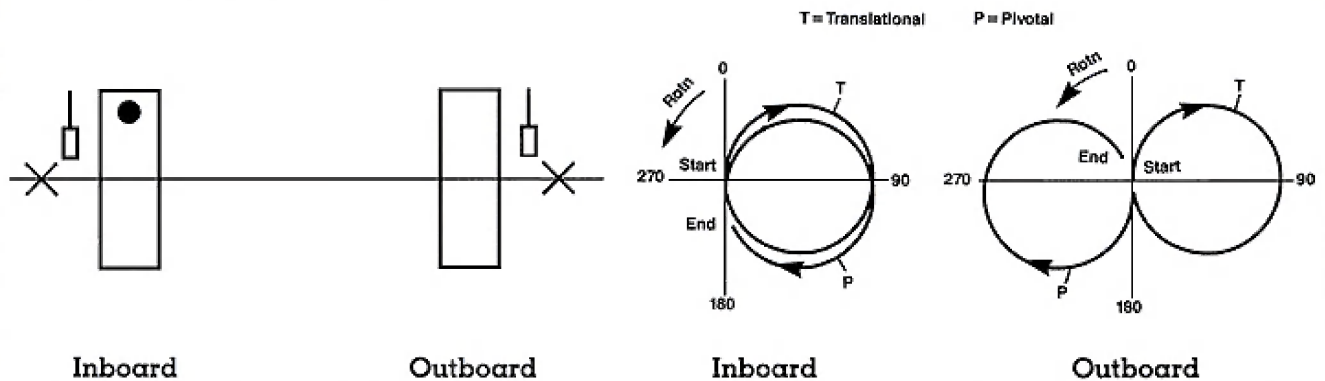
Now move the masses outboard of the bearings. With the same imbalance conditions, the synchronous response is:



| Inboard | Outboard | Inboard | Outboard |
|---|---|---|---|
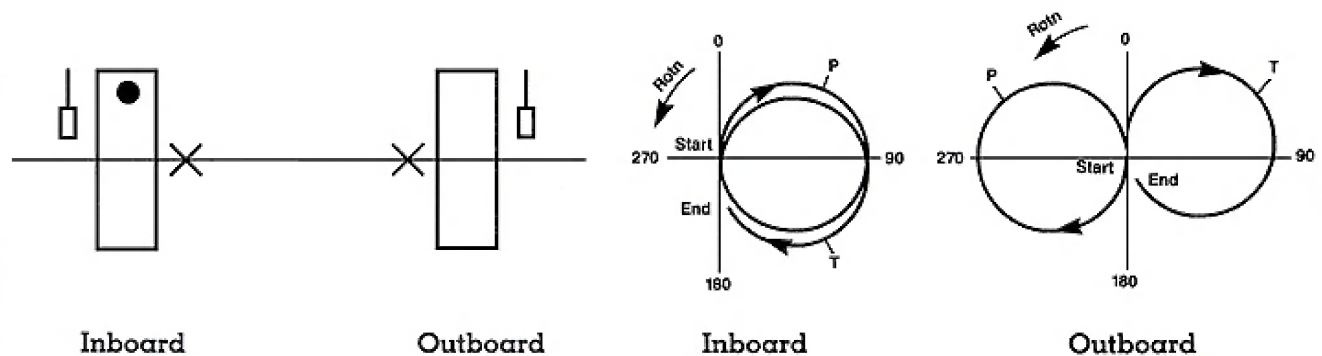
OK so far? Now, put the masses right on top of the bearings (with the masses split in two or by whatever means) so that the translational and pivotal lateral balance resonances are at exactly the same frequency. Now, the puzzle: (remember, no tricks, and the quadrature stiffness which restrains the motion at resonance is the same for translational and for pivotal action). What are the inboard and the outboard responses due to the same imbalance at 0° on the inboard end?



| Inboard | Outboard | Inboard | Outboard |
|---|---|---|---|
| **The Situation** | | **Result** | *(Solution on page 30)* |